Comment on "A landscape theory of aggregation"

Serge Galam

Laboratoire des Milieux Désordonnés et Hétérogènes *
Tour 13 - Case 86, 4 place Jussieu,
75252 Paris Cedex 05, France

B. J. Pol. S. 28 (1998) 411-412

Abstract

The problem of aggregation processes in alignments is the subject of a paper published recently in a Statistical Physics Journal (Physica A230, 174-188, 1996). Two models are presented and discussed in that paper. First the energy landscape model proposed by Axelrod and Bennett (B. J. Pol. S. 23, 211-233, 1993), is analysed. The model is shown not to include most of its claimed results. Then a second model is presented to reformulate correctly the problem within statistical physics and to extend it beyond the initial Axelrod-Bennett analogy.

*Laboratoire associé au CNRS (URA n° 800) et à l'Université P. et M. Curie - Paris 6

Mathematical tools and physical concepts might be a promising way to describe social collective phenomena. Several attempts along these lines have been made, in particular to study political organisations [1], voting systems [2], and group decision making [3]. However, such an approach should be carefully controlled. A straightforward mapping of a physical theory built for a physical reality onto a social reality could be rather misleading.

In their work Axelrod and Bennett (AB) used the physical concept of minimum energy to build a landscape model of aggregation [4]. On this basis, they study the coalitions which countries or firms could make to optimize their respective relationship, which is certainly an interesting problem. To achieve their purpose, they constructed a model of magnetic disorder from the available data for propensities of countries or firms to co-operate or to conflict. Using their model, they drewn several conclusions based on the existence of local frustration between the interacting parties [5].

However, there was some confusion in their use of physics, and they did not stick to their equations. In their model, unfortunately, the disorder is only apparent in the existence of just two energy minima. It is called the Mattis spin glass model [5]. It has been shown that performing an appropriate change of variables, removes the disorder and the model then becomes identical to a well ordered system, the zero temperature finite size ferromagnetic Ising model [6].

In contrast, most AB comments and conclusions are based, on the existence of frustration in the countries or firms interactions [5]. Such local frustration would produce a degeneracy of the energy landscape which in turn would yield instabilities in the global system. However, there is no frustration in the model they derived from their data.

In fact they are confusing two models associated with disordered magnetic systems: one without frustration, the Mattis spin glass model, and one with frustration, the Edwards-Anderson spin glass model [5]. The AB model turns out to be of the Mattis spin glass type, while all their comments are drawn from the physics associated with an Edwards-Anderson spin glass model. Most of Axelrod and Bennett's conclusions cannot be drawn from their model.

To demonstrate our statement requires the use of some mathematical technicalities which are lenghty and not appropriate to the present journal. Therefore our demonstration has been published in a Physics journal [7], where first, the AB model is analysed within the field of Statistical Physics [6] and then the conclusions mentioned above are demonstrated. Furthermore, we are able to build up a new coalition model to describe alignment and competition

among a group of actors [7]. Our model does embody the main properties claimed in the AB model. Morevover it also predicts new behavior related to the dynamics of bimodal coalitions. In particular the stability of the cold war period and the East European fragmentation process induced by the collapse of the Warsaw pact are given an explanation.

References

[1] S.J. Brams, *Measuring the concentration of power in political systems*, American Political Sciences Rev. **62**, 461 (1969).

[2] S. Galam, *Paradoxes of majority rule voting*, Int. J. General Systems **18**, 191 (1991)

[3] S. Galam and S. Moscovici, *Towards a theory of collective phenomena: consensus and attitude changes in groups*, European J. Soc. Psy. **21**, 49 (1991).

[4] R. Axelrod and Bennett, *A landscape theory of aggregation*, B. J. Pol. S. **23**, (1993).

[5] K. Binder and A. P. Young, *Spin glasses: experimental facts, theoretical concepts, and open questions*, Review of Modern Physics **58**, 801 (1986).

[6] R. K. Pathria, *Statistical Mechanics*, Pergamon Press**45**, (1977).

[7] S. Galam , *Fragmentation versus stability in bimodal coalitions*, Physica **A**230, 174-188 (1996).